NAS 1.46: 18/10, 11, 12
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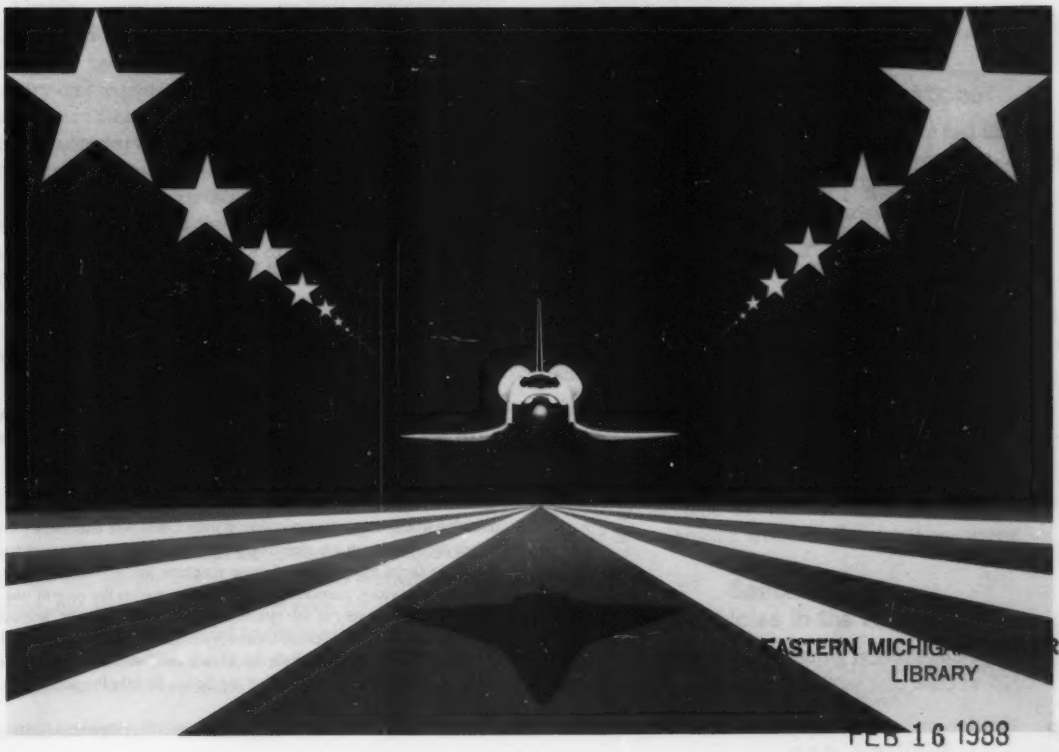
NASA Activities

National
Aeronautics and
Space
Administration

Winter 1988 : **Special Edition**

LOOKING FORWARD...



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About the Cover

NASA IS LOOKING FORWARD...

Cover and Back Cover

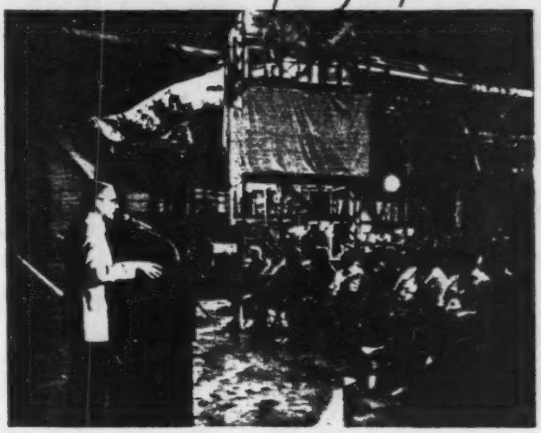
"A Tear Of Price," acrylic by Wellington Ward. As I stood on the grassy plot next to the quiet waters at the Kennedy Space Center, my full sensitivity as a human being, savored the sights and sounds of the Shuttle as it roared ever upward with majesty and grace. As I turned to observe the reactions of the faces in the crowd, I saw reflected in the sunglasses of a few, a drama that was unfolding before me. Although the glasses mirrored the action of the moment, it was the facial expressions of those watching that told the real story; one of honor, glory, patriotism. Just a single tear on the face of one summed up the beauty of the moment. It was a tear of pride. Mission 51-D, Kennedy Space Center, Discovery lifted off on April 12, 1985.

"The Return", oil on canvas by Alvara Guillot. This painting represents the future come back of the Space Shuttle Program.

NAS 1.46: 18/10, 11, 12

NASA INTERVIEW WITH ADMIRAL TRULY

This column features excerpts from an interview with Rear Admiral Richard Truly, associate administrator for space flight. The interview was originally taped for broadcast on NASA's radio program, NASA Space Story



"I think you're doing a damned super job."

FROM WHERE HE SEES IT—Rear Adm. Richard Truly, NASA's associate administrator for space flight, tells Kennedy Space Center crews in the Orbiter Modification and Refurbishment Facility how pleased he is with their efforts to return space shuttles to flight.

Looking Back at 1987 Milestones

Nineteen eighty-seven has been a major year in the recovery of getting back to the flight of the shuttle. We reported back to the President on our one year required report and answered to him or described to him all the things that we were doing on the recommendations from the Rogers Commission. We finalized the design of the solid rocket motor redesigned. We agreed on the various other changes that we're making in the Shuttle system. And the morale during 1987 of the people across the system both at the Kennedy Space Center, Johnson Space Center, Marshall and at our contractors just went sky high, compared to the way it was after the accident.

Looking Forward to 1988

Looking ahead to next year, we have a tremendous job to do. We have the final testing on the solid rocket motor, we have the flight readiness firing of the Discovery on the pad prior to the launch. We have a design certification review which is a paper exercise that is necessary before we fly again. We have final training of the crews, not only the flight crews that's going to fly the twenty-sixth Shuttle mission, but also the ground crews and the launch crew at Cape Kennedy and the mission control crews at the Johnson Space Center. So it's going to be a busy year, and that just gets us half way through it. We have two more flights in 1988 that are scheduled after the first flight. But it's that first one that we are really pointing at and I am looking forward to it.

"A Very Needed Breather"

I think that when the turn of the century comes and we look back at 1987 and 1988, we will see 1987 as a very needed breather in the total space program. We will see it as the year that we not only recovered the orbiter and set the architecture for that recover in place, but also we looked at the need for expendable launch vehicles in parallel to the orbiter, the so called mixed-fleet. And by the turn of the century, that mixed-fleet will very much be a reality. We also will see 1987 as the year that we did the practical work that started the Space Station for which the Shuttle and also expendables will support. Nineteen eighty-eight I think will be viewed as the year that the execution of this breather, planning took place. Nineteen eighty-eight will be looked at as the start of a logical buildup and a real capability in the 1990's.

"Space Shuttle is the Backbone"

I believe that this breather that we have had has allowed us to look at our overall space program. And it has clearly shown that the Space Shuttle is the backbone of our capability in space transportation. The satellite repairs, the delivery of satellites to orbit, the discoveries and the science being done by men and women with the Shuttle it's going to be redone in space again over the next decades. The Shuttle will be with us into the 21st century. It is the most important and the most capable space transportation system that is in the world today. I think that the accident, even though it was a horrible and tragic affair, will be viewed in the context of other aviation accidents. It will be one that we look back and wish we had never had to go through, but the real stability and the depth of the Space Shuttle will far outlast that one event.

Space Launch Vehicles in the Future

I think that the Space Shuttle is going to be flying well into the next century, maybe into 2005 or 2010. I

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"Hail, The long Distance Voyagers Mission 51-L—In Loving Memory", by Robert A. M. Stephens. In this oil painting, the artist expresses himself regarding the Challenger tragedy with a mixture of feelings. The sadness of a mood provoking image of an empty launch pad. The dramatic heavy aftermath of smoke as it drifts across the landscape. A promise of an optimistic future as the sun breaks through below the cloud and the flight of seven birds, symbolic of continuing space.

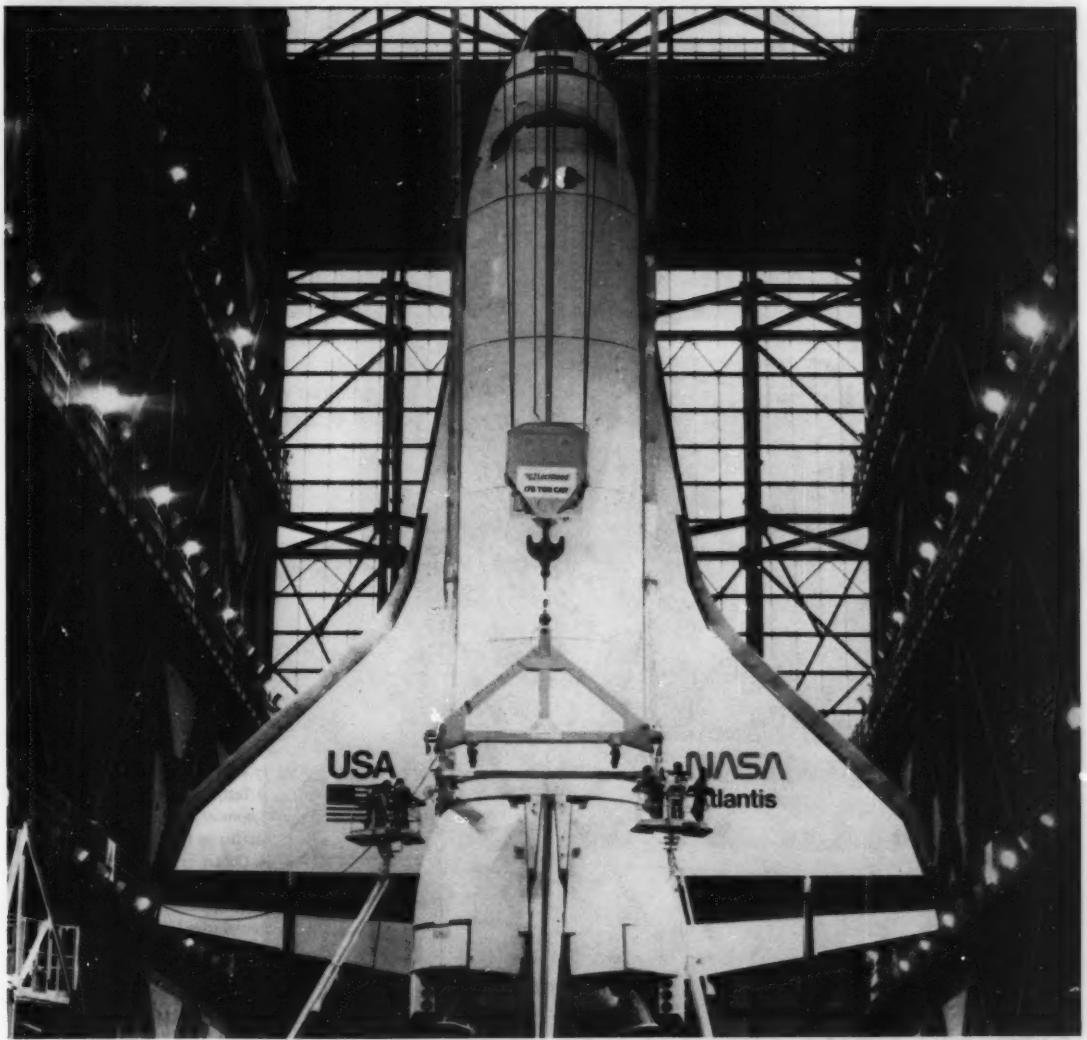
think it will be balanced by expendable launch vehicles of several classes, small vehicles of a few hundred pounds to low-Earth orbit ranging, to a heavy lift capability of hundred and thousands pounds or a hundred and fifty thousand pounds which will be necessary for major new initiatives either in national security or going back to the moon or a mission to Mars or for some logistics to support to the Space Station. I think that when the century turns in the year 2000, we will see a whole variety of space launch vehicles. And we will be working by that time on new technologies and new vehicles to replace the Shuttle. And boosters that may by themselves and without man fly themselves back to the Cape so that we save money and don't throw them away on each launch.

"Highs and Low Points"

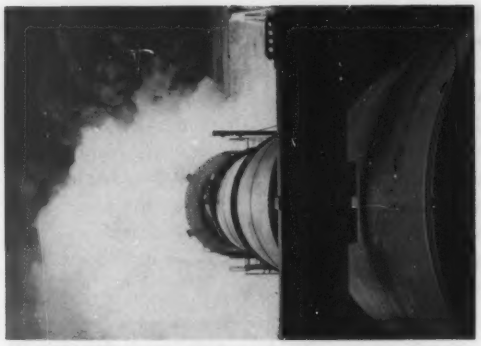
My experience over the last couple of years has been a unique one. It's been one where I have been in charge of leading an outstanding group of people within NASA and our contractors across the country in recovering the Shuttle. In a larger view, choosing and articulating and arguing for an architecture for the future in space transportation, not just the Shuttle but a mix of Shuttles and ELV's and new capabilities and technologies. The highs and low points have been very high and very low. There have been some great frustrations. I think the greatest frustration has been to have these great people in this magnificent and successful program be criticized. But on the other hand, I think we deserved some of that criticism, so my approach to that frustration has simply been to try to build a team that will win our credibility back. I have no doubt that we will do that and as a matter of fact, I think we already have. I think that our recovery program is extremely sound. The high point of the work has simply been watching this team come back together. We have a situation at the Johnson Space Center and the Kennedy Space Center and the Marshall Space Flight Center where we have better team spirit, better cooperation and, better work going on than any time in the space business that I've ever encountered—and I've been in it most of my adult life. to watch these individuals under very trying circumstances recover the space program and still be looking to the future has been one of the highlights of my personal career and frankly, it's been a lot of fun and I have enjoyed it.

"We can be World Leaders if we Choose to be."

I believe that one of the most important things that we have done during this down time is to have a breather and to have the Nation look at it's national space policy. I believe that that policy should be a very bold one and one that balances capability for our protection, our national security, with our dreams of a civil space program and exploration and moving humans beyond Earth farther into the solar system. Also, be aggressive in our plans to do space science, space exploration and to bring the technologies that it took to do that back home to Earth. I think that the dreams that we have enjoyed in America and the space program even though they have been set back by the Challenger accident are all still valid. And as we look to the future, I think that we should not forget that. I believe that space is an inherent part of our America life and nothing will change that. We can be world leaders if we choose to be. That's one of the nice things about this particular debate, we can be what we want to be in space.

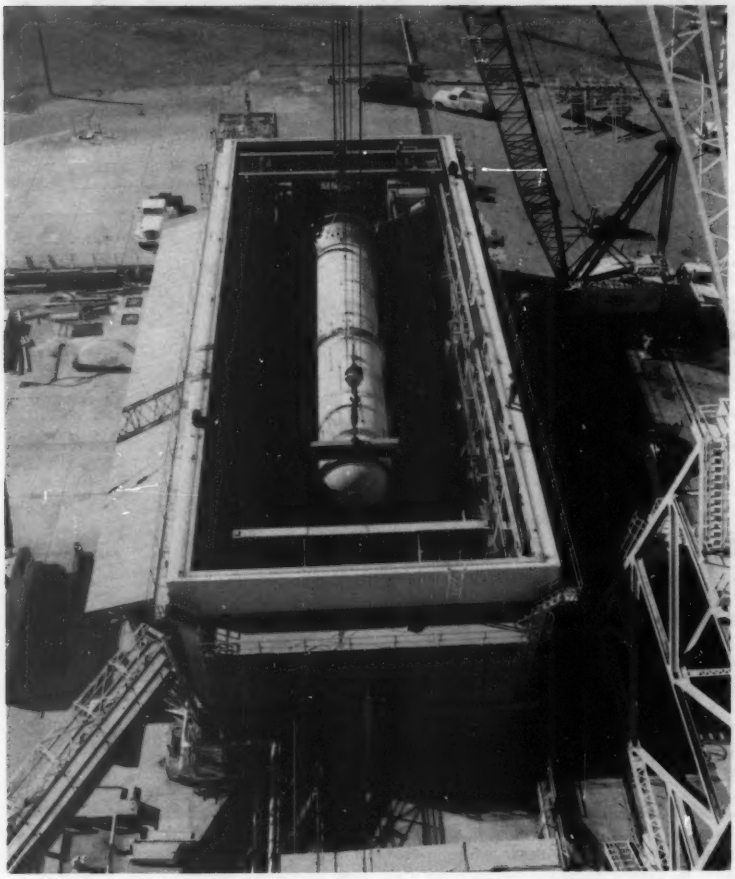


The Orbiter Atlantis hangs above the transfer aisle in the Vehicle Assembly Building after being hoisted from the Space Shuttle stack in high bay 3 during destack operations. In the next and final step of the operation, Atlantis will be lowered to a horizontal position and placed on its own landing gear. After destack Atlantis will be moved to the Orbiter Processing Facility where it will begin an extended processing flow to undergo return-to-flight modifications and preparations for the STS-27 mission.



May 27, 1987—Static test flying of Engineering Test Motor (EDM-1) is successfully completed at the Wasatch, Utah, facility of Morton Thiokol Corp., NASA's prime contractor for the Space Shuttle solid rocket motors. This test motor consisted primarily of original motor case hardware, that is without the capture feature and third o-ring being implemented in the SRM redesign.

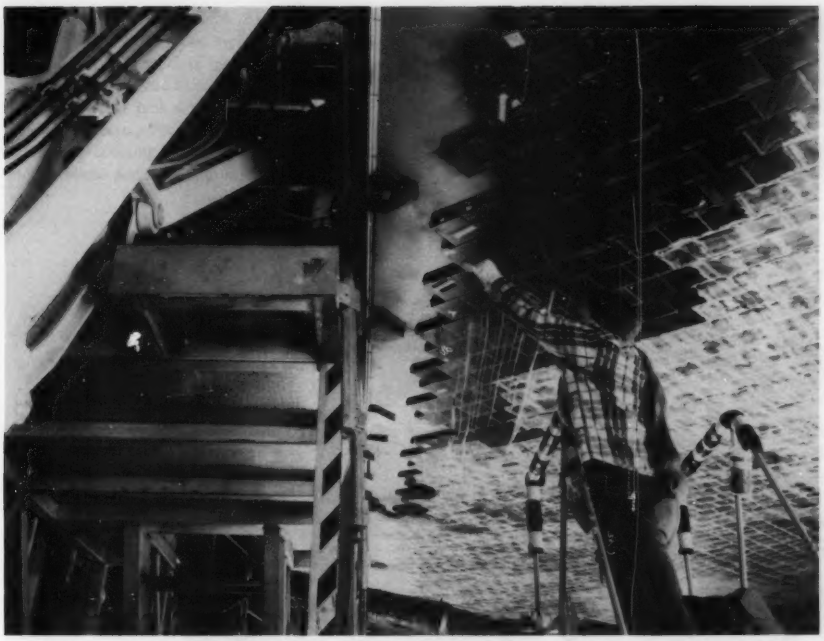
Aug. 30, 1987—The first full-duration test firing of the redesigned Space Shuttle solid rocket motor is conducted at Morton Thiokol's Space Division near Brigham City, Utah. The test of the 126-foot-long, 1.2 million-pound Development motor (DM-3) was designed to evaluate the performance of the major design features of the redesigned solid rocket motor, including the capture feature field joint, bonded field joint insulation, joint heaters and radially-bolted case-to-nozzle joint design.



TESTS

Space Shuttle Solid Rocket Booster Structural Test Article Lowered Into Test Facility At Marshall

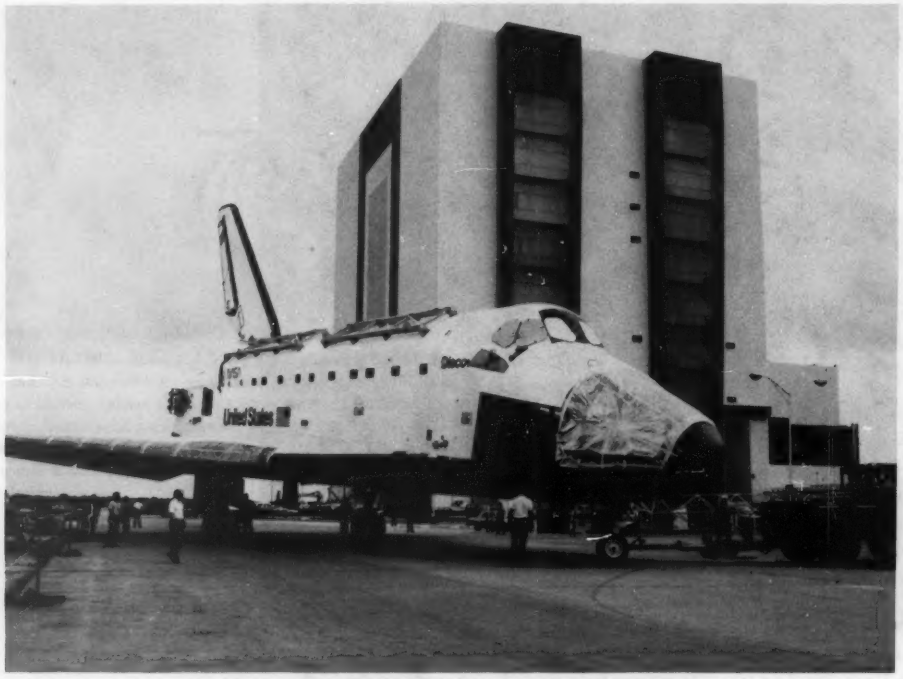
Structural Test Article-3 (STA-3), a 50-ton solid rocket booster test article, is lowered into a test facility at NASA's Marshall Space Flight Center in Huntsville, Ala. This Space Shuttle solid rocket booster test article will be used to verify the structural integrity of the redesigned solid rocket motor case, the redesigned external tank attach ring and redesigned aft skirt. During testing, maximum loads and internal motor case pressures will be applied to the test article. Testing will last three months and is part of a series of solid rocket booster tests being conducted by the Marshall Center.



Work on the thermal protecton system continues on the Discovery in the Orbiter Processing Facility High Bay 1 as tile technicians help prepare the ship for the next Space Shuttle Flight, presently targeted for June 1988. Discovery is scheduled to be launched from KSC's Launch Pad 39-B on a four day mission to deploy a Tracking and Data Relay Satellite.

PREPARATION

STS 26 Training—The five veteran astronauts recently named to man the Discovery for the STS 26 mission are pictured prior to a training session in the nearby motion base Shuttle mission simulator. Astronaut Frederick H. Hauck, right, is mission commander. He is standing by Astronaut Richard O. Covey, pilot. Mission specialists on the front row are (l.-r.) Astronauts George D. Nelson, David C. Hilmers and John M. (Mike) Lounge.

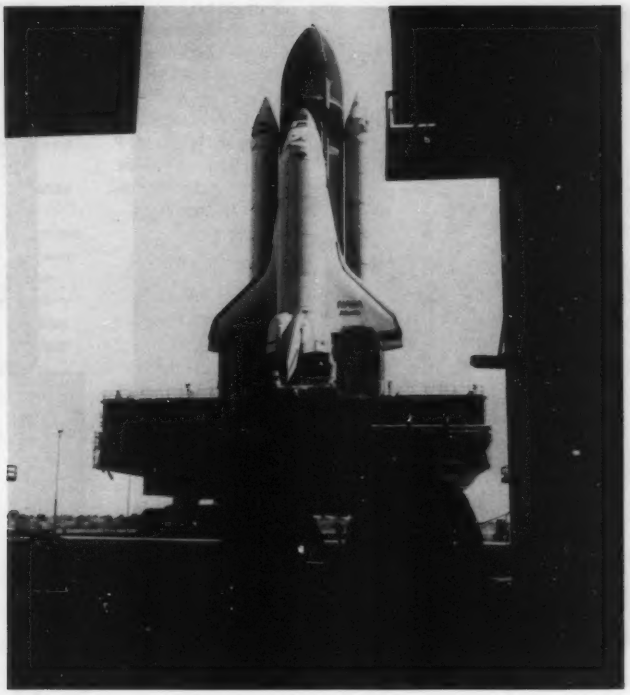


Discovery is rolled back to the Orbiter Processing Facility from the Vehicle Assembly Building where return to flight modifications will be made. This is the first step in preparing the orbiter for the next scheduled launch (STS-26) in June 1988.

Personnel in Firing Room 1 of the Launch Control Center at Complex 39 monitor orbiter status as Discovery was powered up August 3rd.

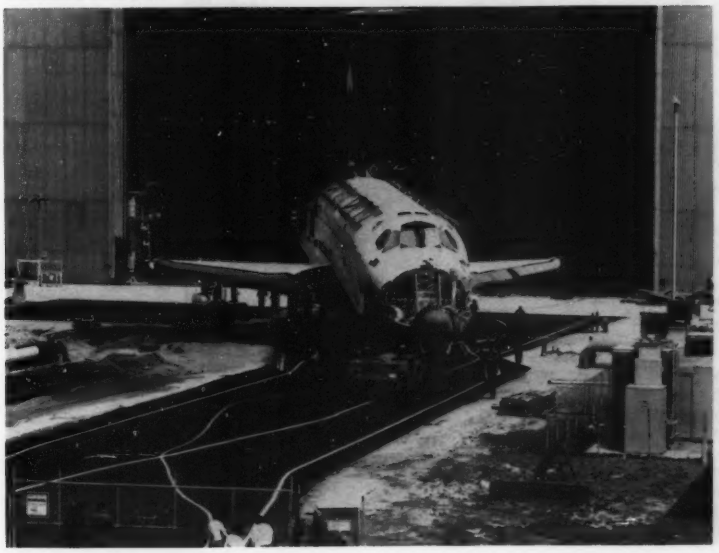
SHUTTLE

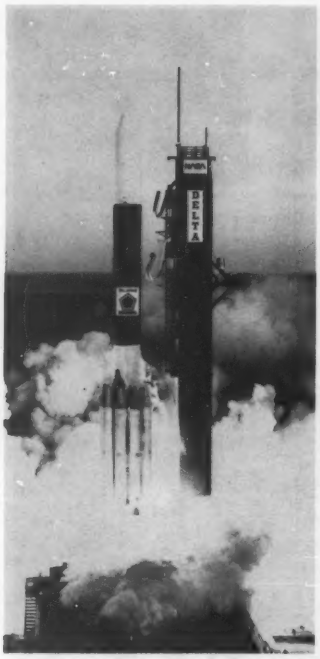
The Space Shuttle Atlantis is transferred from the Vehicle Assembly Building high bay 1 to high bay 3 as preparations for destack of the orbiter begins. The orbiter will be hoisted from the Solid Rocket Boosters and the External Tank and will be rolled over to the Orbiter Processing Facility. Once there it will begin an extended processing flow to undergo return-to-flight modifications and preparations for the STS-27 mission.



SHUTTLE

The orbiter Columbia is backed into the Vehicle Assembly Building (VAB) after being rolled out of the Orbiter Processing Facility.





Delta 182 is launched into the late afternoon sky at 5:22 pm EST from launch complex 17-B on the Cape Canaveral Air Force Station. Delta 182 is carrying the Palapa B2-P communications satellite into orbit for the government of Indonesia.

Atlas/Centaur-66 Carrying the FLTSATCOM F7 communications satellite is launched on December 4, 1986 at 9:30 p.m. EST from Cape Canaveral.

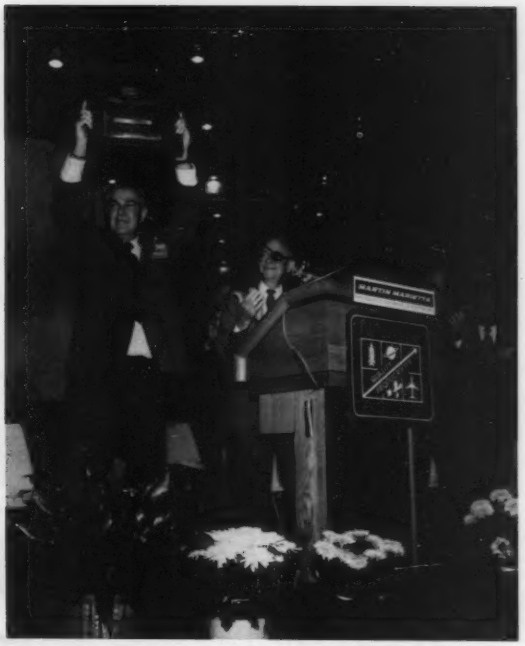
LAUNCHES

Blockhouse during A/C 66 launch of FLTSATCOM F7

AWARDS

NASA Honors Excellence—October 21 and 22, 1987—NASA presented its first "NASA Excellence Award for Quality and Productivity" to IBM Federal Systems Division in Houston, Texas, and Martin Marietta Manned Space Systems in New Orleans. The two companies were selected from seven finalists.

Mr. Steve Hudson (center), general manager of IBM Federal Systems Division and A.J. Macina (left), manager of Onboard Shuttle Software for IBM, accepts the Excellence Award from NASA Deputy Administrator Dale Myers (right) on behalf of the 320 employees who produced top quality, error free programming for Space Shuttle missions and cut the time it takes to reconfigure the spacecraft's programming.



Top: **Dale Myers presents** NASA Excellence Award for Martin Marietta Manned Space Systems' work in designing and building the 154 foot external tank that provides fuel for the Space Shuttle orbiter. (From left) Richard M. Davis, president of Martin Marietta Manned Space Systems; Dale Myers, NASA Deputy Administrator; Senator J. Bennett Johnston, D-La; Edwin Edwards, governor of Louisiana.

Left: **NASA gets an emmy award**—An Emmy Award for outstanding achievement in engineering development was presented to NASA for developing satellite technology which ultimately improved television broadcasting throughout the world. The Communications Technology Satellite (CTS), launched in 1976, was the first to use a high-efficiency, high-powered transmitting tube developed at the Lewis Research Center. The tube, which enabled the CTS to operate at power levels 10 to 20 times higher than those used at the time and in a new frequency band, made it possible to use much smaller and far less expensive ground receiving equipment than ever before.

Researchers at Lewis are currently working on the Advanced Communications Technology Satellite (ACTS), which is expected to provide equally significant benefits.

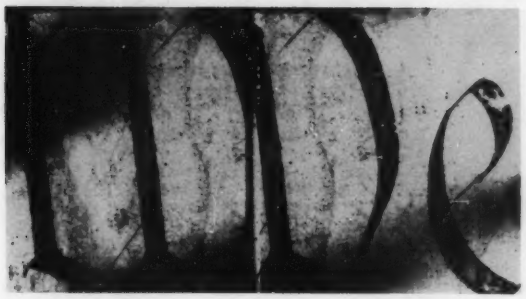
1987 Americas Cup Winner, "Stars and Stripes," made use of riblet technology invented by NASA's Langley Research Center and manufactured by 3M Company. Riblet film was used to cover the entire underside of the yacht.

SPIN-OFFS

From Space to Earth—Over the years, much of NASA's technolgy has been used successfully in the commercial marketplace. Today, the Kangaroo shoe company is using a material that was originally part of Apollo astronaut's boots in its walking and running shoes.

Taking a Closer Look On The Constitution's 200th Birthday

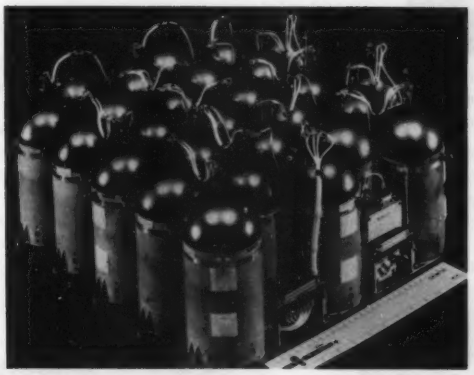
The Charters of Freedom Monitoring System's Image Acquisition System consists of a CCD camera (configured) with precision controlled illuminators, which is scanned over the documents by a high precision positioning system. The camera, illuminators, and positioning system are mounted on a vibration—isolated optical table. The Image Acquisition System is located in a special environmentally controlled darkroom.



We The People

Two images of the "W" in "We the People" from the first page of the Constitution. Loss of ink from the letters is clearly visible, as are large-scale wrinkles, or "cookies" in the parchment (shaded areas).

Space Station Nickle-Hydrogen Battery Pack.
NASA Lewis Research Center



SPIN-OFFS

Below: Ocular Screening System: Developed in Wedowee

A new eye testing device developed by the Medical Services Corporation in Wedowee, Alabama. The Ocular Screening System is based on technology used by NASA's Marshall Space Flight Center to analyze pictures taken during Skylab mission in the early 1970's.

Astro Film 'E'

A 28.4 million cubic feet volume balloon, carrying a 3000 pound payload, utilizing a newly developed balloon grade film designated "Astrofilm 'E'" This flight was conducted as part of NASA's Balloon Program which is managed by the Wallops Flight Facility/Goddard Space Flight Center.

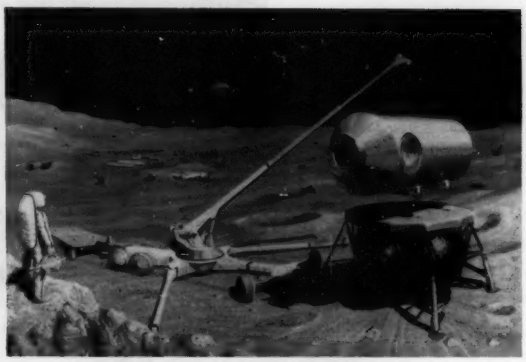
The NASA Balloon Program provides support for approximately 50 flights per year to the high energy astrophysics, astronomy, and upper atmospheric research disciplines as well as non-NASA support science programs both national and international.

NASA Administrator Dr. James C. Fletcher, flanked by AA for Space Station Andrew Stofan (left) and Deputy AA for Space Station Thomas Moser, announces Space Station Contractor Awards.

Teacher In Space Barbara Morgan tells students, "the future is sitting in my classroom every morning. It is bright; it is eager."

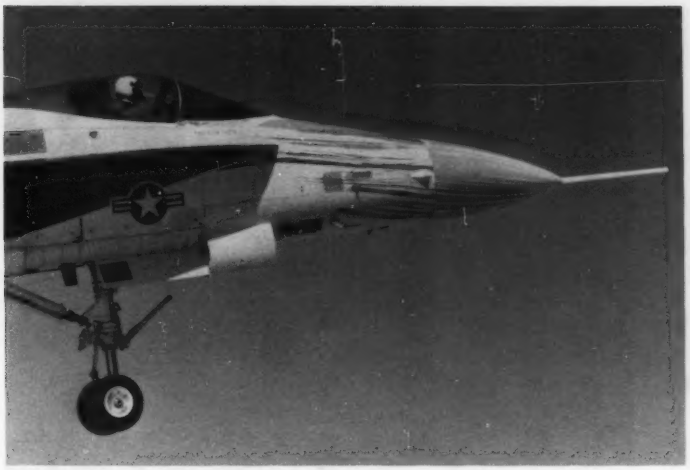
LOOKING FORWARD

Orbiter particle flow on IRIS workstation with keyboad, mouse & monitor.



FROM THE OFFICE OF EXPLORATION
LOOKING INTO THE FUTURE

One of the types of missions considered for the Space Station in the next century is one that would call for the complex to isolate samples from Mars and comets which would be returned in unmanned probles. A common module is unloaded from an expendable-lander.

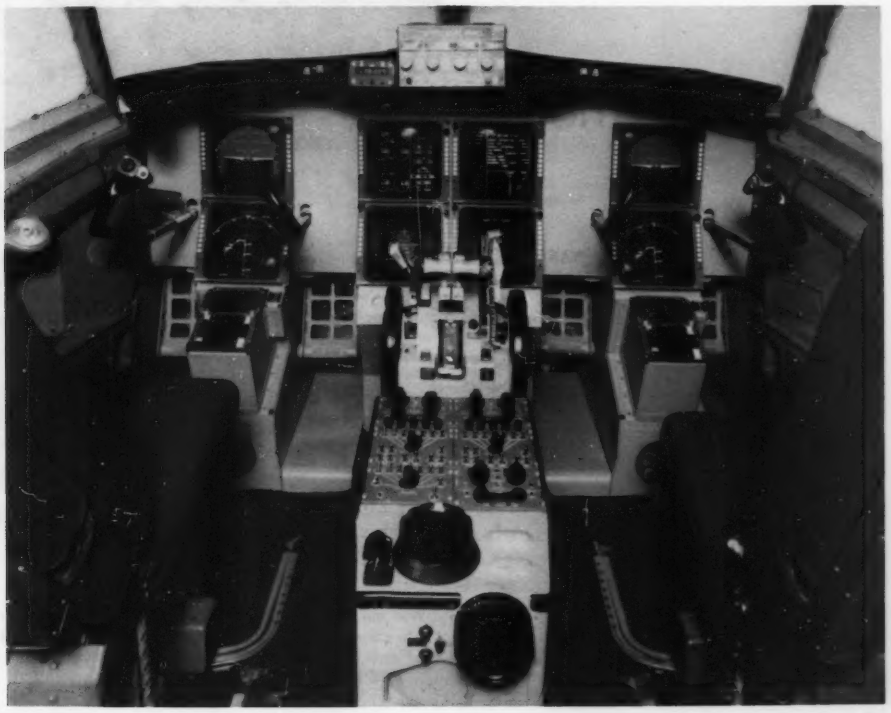


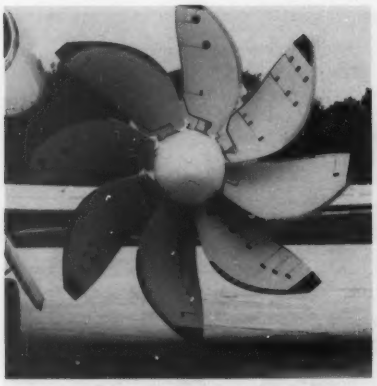
NASA Ames-Dryden Flight Research Facility, Edwards, CA...NASA Research Pilot; Einar X. Enevoldeon actuates a colored dye system that helps visualize surface flow over the nose of a specially equipped and instrumented F/A-18 research aircraft at Ames-Dryden Flight Research Facility. This initial test was accomplished at a low angle of attack. Later tests will use the dye system and a smoke generation system to visualize airflow in NASA's High Alpha Flight Research program. High Alpha or high angle of attack means the aircraft is nose high relative to its flight path. NASA researchers aim to gather data to make future aircraft supermaneuverable, safer and more controllable in high alpha flight.

LOOKING FORWARD

ATOPS

As part of a major upgrade of ATOPS research facilities, the Transport Systems Research Vehicle (a specially-instrumented Boeing 737) has received a new all-electronic display flight deck similar to this artist's concept. Its display should replace virtually all of the traditional round display indicators and will enhance flight performance. The TSRV serves as a flying laboratory to investigate technology options for modern aircraft flying in the evolving national airspace system.





Flight testing of an advanced, fuel-saving type propeller called a "propfan" is currently underway. NASA's Lewis Research Center, Cleveland, Ohio, is funding and managing this $56 million research effort, called Propfan Test Assessment (PTA). Lockheed-Georgia is the prime contractor.

The propfan propulsion system is mounted on the left wing of a Gulfstream II business jet. Data gathered in the flight research program will aid engineers in designing a new generation of propfan-propelled aircraft.

Aircraft equipped with propfan propulsion systems will burn 15-30 percent less fuel than the most advanced tubofan-powered aircraft flying in the 1990's while flying at the same speeds.

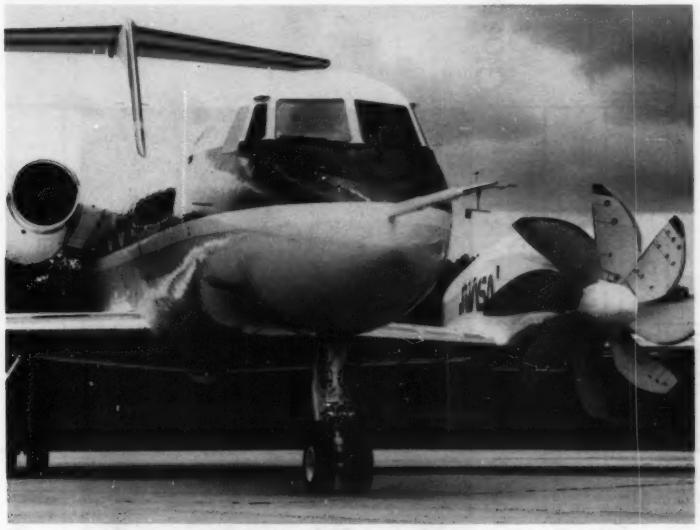
AERONAUTICS

San Francisco Bay Aerial with U2 NASA 709.

NASA's ER-2 Arrives at Ames: The NASA ER-2 aircraft, an updated, larger version of the U-2, arrives in June 1981 at Ames Research Center from Lockheed-California Company of Southern California. The new aircraft joins the two Ames' U-2 airplanes in surveying the Earth's resources for land use development, water resource evaluation, disaster assessment and stratospheric sampling. The ER-2 and the U-2 aircraft are built by Lockheed-California Company of Burbank, Calif.

XV-15 Tilt Rotor Reserach Aircraft

Two NASA/Army research aircraft with helicopter-like rotors, which tilt up for vertical takeoff and landing and tilt forward for horizontal flight, were built by Bell Helicopter Textron, under a joint research program of NASA's Ames Research Center and the U.S. Army Research and Technology Laboratories (AVRADCOM), at Moffett Field, California.



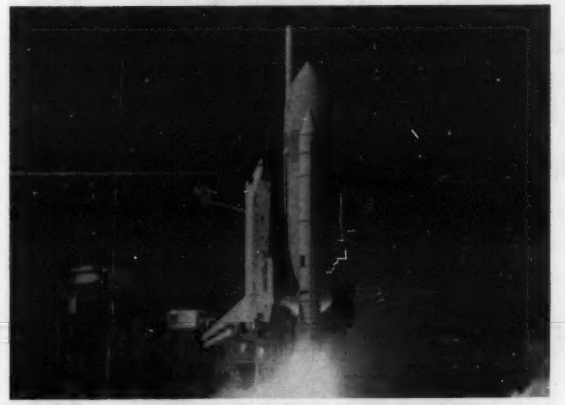
Propfan

In an effort to increase the fuel efficiency of today's jet liners, NASA has developed an advanced propeller called the propfan. It is shown here mounted on the wing of a gulfstream 2 business jet for test flights. A propfan driven engine would burn 50 to 60% less fuel, and could start appearing on commercial airliners in the early 1990's.

NASA ACTIVITIES

SHUTTLE PAYLOAD FLIGHT ASSIGNMENTS OCTOBER 1987

FLT	DATE ORBITER	INCL ALT	CRW DUR	PAYLOAD	CARRIER
26	DISCOVERY	28.5 160	5 4	TDRS-C	IUS
27	ATLANTIS	XX X	5 X	DOD	
28	COLUMBIA	XX X	X X	DOD	
29	DISCOVERY	28.5 A60	5 4	TDRS-D	IUS



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ELV PAYLOAD FLIGHT ASSIGNMENTS OCTOBER 1987

DATE YR MO	LAUNCH VEHICLE TYPE	PAYLOAD ORBIT	LAUNCH SITE	PAYLOAD
88 01	DELTA 181	LEO	ESMC	DOD-2
88 02 *	ATLAS 63E	SS	WSMC	NOAA-II
88 03	SCOUT S-206C	LEO	SMR	SAN MARCO-DE
88 05	SCOUT S-212C	LEO	WFF	ITV-2
88 08	DELTA 183	LEO	ESMC	DOD-3
88 08	SCOUT S-213C	LEO	WSMC	SOOS-3
88 10 *	ATLAS CENTAUR 68	GSO	ESMC	FLTSATCOM-F8
89 02	DELTA 184	SS	WSMC	COBE
89 02	SCOUT S-214C	LEO	WSMC	SOOS-4
89 03	ATLAS 50E	SS	WSMC	NOAA-D
89 05	SCOUT S-215C	LEO	WFF	ITV-3
89 08	SCOUT S-210C	LEO	WSMC	NOVA-II
90 02	DELTA	LEO	ESMC	ROSAT

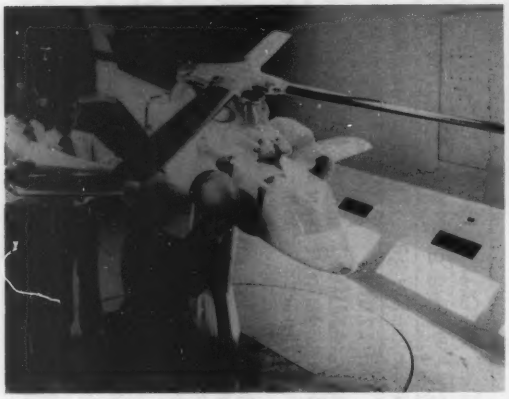
31	DISCOVERY	28.5 320	5 5	HST	UNIQUE
32	COLUMBIA	28.5 190	7 7	ASTRO-1	I G + 2 PAL
33	89 8 24 ATLANTIS	XX X	X X	DOD	
34	DISCOVERY	34.3 145	5 4	GALILEO	IUS
35	COLUMBIA	28.5 160	5 5	GPS-1 IBSS	PAM-D2 SPAS
36	ATLANTIS	XX X	X X	DOD	
37	COLUMBIA	28.5 160	5 5	GPS-2 SYNCOM IV-5	PAM-D2 UNIQUE
38	DISCOVERY	33.4 175	7 7	STARLAB	L M + 1 PAL
39	ATLANTIS	XX X	X X	DOD	
40	COLUMBIA	28.5 160	5 4	GRO	
41	DISCOVERY	XX X	X X	DOD	
42	ATLANTIS	28.5 160	5 4	TDRS-3	IUS
43	COLUMBIA	28.5 160	5 7	SKY-NET-4A EU-RLCA-1L	PAM-D2
44	DISCOVERY	28.5 160	5 4	ULYSSES	I U S / PAM

90 02	SCOUT S-218C	LEO	WSMC	TRANSIT-27
90 03	ATLAS CENTAUR	GSO	ESMC	GOES-1
90 05	SCOUT S-216C	LEO	WFF	ITV-4
90 06	ATLAS CENTAUR **	GIO	ESMC	CRRES
90 06	ATLAS 34E	SS	WSMC	NOAA-1
90 08	SCOUT S-211C	LEO	WSMC	TRANSIT-28
90 12	ATLAS CENTAUR	GSO	ESMC	GOES-J

Glossary

ASTRO	Ultraviolet Astronomy Telescope	**LEO**	Low Earth Orbit
COBE	Cosmic Background Explorer	**MAGELLAN**	Venus radar mapping
CRRES	Combined Radiation Release Experimental Satellite	**NOAA**	National Oceanic and Atmospheric Administration
DOD	Department of Defense	**NOVA**	Advanced Navy Navigation Satellite
EO	Escape Orbit	**PAM**	Payload Assist Module
ESMC	Eastern Space and Mission Center	**ROSAT**	Roentgen Satellite
EURECA	European Retrievable Carrier	**SAN MARCO**	NASA/Italican Earth physics satellite
FLTSATCOM	Fleet Communication Satellite	**SMR**	San Marco Range
GALILEO	Jupiter probe	**SOOS**	Stacked U.S. Navy Navigation Satellites
GOES	Geostationary Operational Environmental Satellite	**SS**	Sun Synchronous Orbit
GPS	Global Positioning System	**STARLAB**	DOD Spacelab
GRO	Gamma Ray Observatory	**SYNCOM**	Hughes Geosynchronous Communication Satellite
GSO	Geosynchronous Orbit	**TDRS**	Tracking Data Relay Satellite
GTO	Geosynchronous Transfer Orbit	**TRANSIT**	Navy Navigation Satellite
HST	Hubble Space Telescope	**ULYSSES**	Formerly International Solar Polar Mission
IBSS	Infrared Background Signature Survey	**WFF**	Wallops Flight Facility
ITV	Instrumented Test Vehicle	**WSMC**	Western Space and Missile Center
IUS	Inertial Upper Stage		

Right: **Recent flight tests** over the California Mojave Desert have been demonstrating increased power from jet engines using newly developed engine/flight control integration technology. Increased thrust of 10 percent or more with one engine has been shown with NASA Ames-Dryden's F-15. The program, called HIDEC, or Highly Integrated Digital Electronic Control, trades unneeded engine stall margin for increased performance.

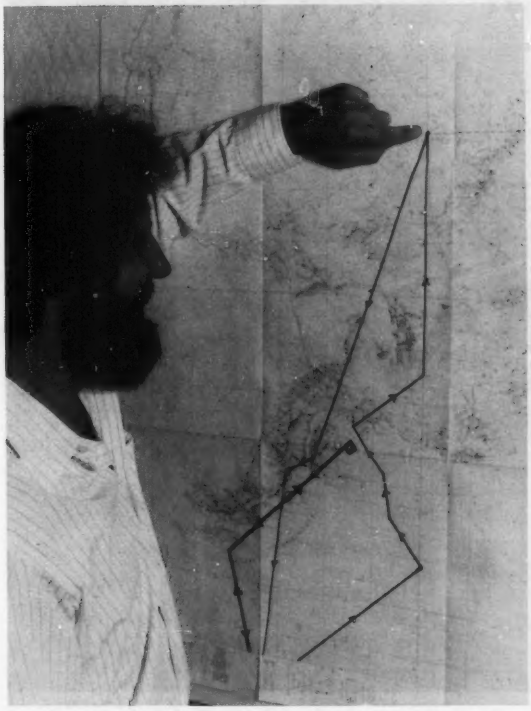


Top: **A test vehicle for the X-wing,** a helicopter rotor that converts to an airplane wing so it can rise vertically, stops its rotors in flight, then fly forward.

NASA's ER-2

Below: **NASA research pilot** Einar K. Enevoldson maneuvers a specially equipped and instrumented F/A-18 research aircraft during a flight in NASA's High Alpha Flight Research Program at Ames-Dryden Flight Research Facility.

AERONAUTICS



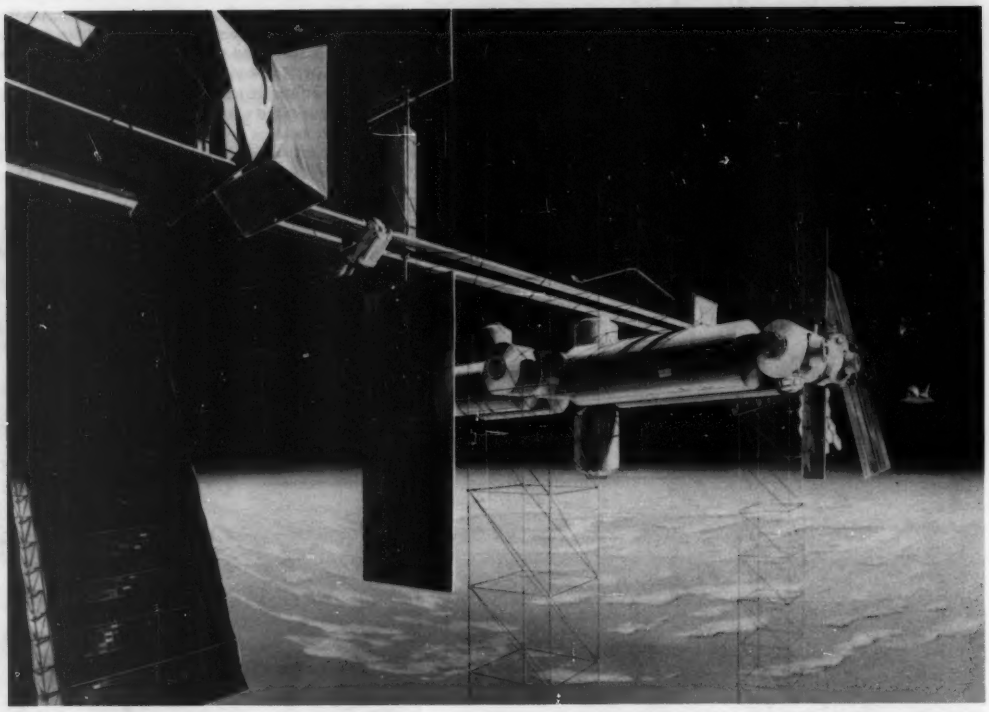
NASA program scientist Bob Watson examines flight plan for the DC-8 flight to South Pole and back to Punta Arenas, Chile. Line is the flight path of the ER-2.

The Galileo spacecraft atop its two-stage Inertial Upper Stage has just been released from the Space Shuttle in this artist's rendering. Galileo is scheduled to be launched to Jupiter in October or November 1989. The configured spacecraft includes the small sunshade atop the furlable antenna and a large sunshade below the antenna to protect the spacecraft and instruments in its 6-year voyage which includes a gravity-assist encounter at Venus and two at Earth to reach sufficient velocity to reach Jupiter by November 1995. The trajectory has been dubbed VEEGA, for Venus-Earth-Earth Gravity Assist.

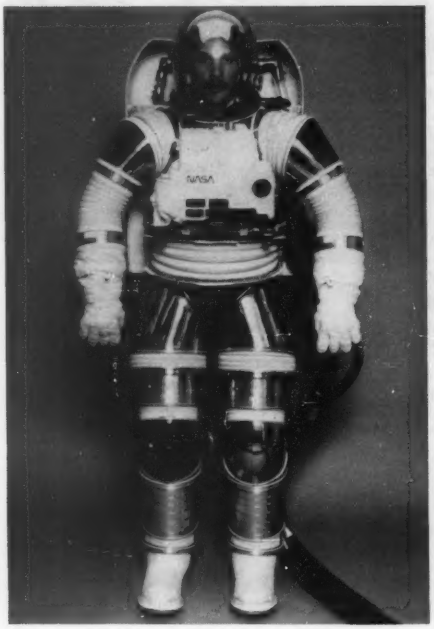
SCIENCE

AIRBORNE OZONE EXPERIMENT

A scientist operates the electronic data handling system for the laser radar experiment which measures ozone and polar stratospheric clouds. She is aboard the DC-8 flying laboratory.



Marshall is managing Space Station Work Package 1, which includes design, development, test, and evaluation of the Station's canister-like laboratory and habitation modules, as well as smaller supply modules and connecting nodes. The work also includes the station's environmental control and life support system.

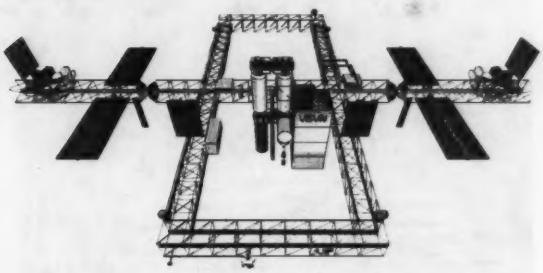


SPACE STATION

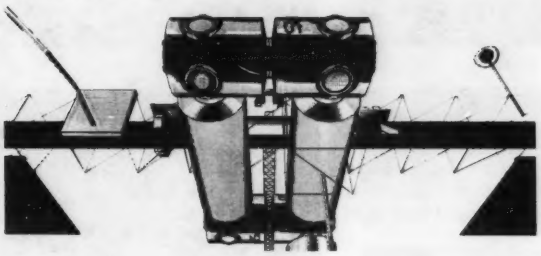
NASA's current ZPS, or Zero Prebreath Suit, slated for use on the space station. The suit allows astronauts to avoid the three to four hours of prebreathing normally needed when going out in space with Shuttle suits at standard cabin pressure. This will allow astronauts on the Space Station to don the suit and respond to needs immediately.

SPACE STATION

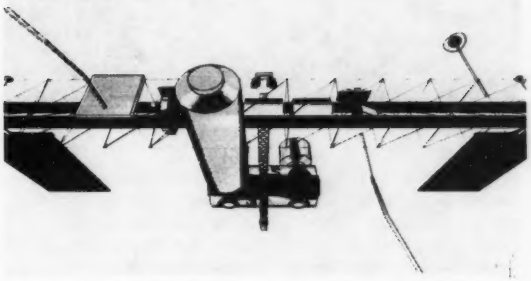
Baseline configuration of the permanently manned Space Station.

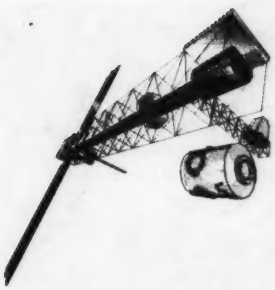


Assembly Flight 8



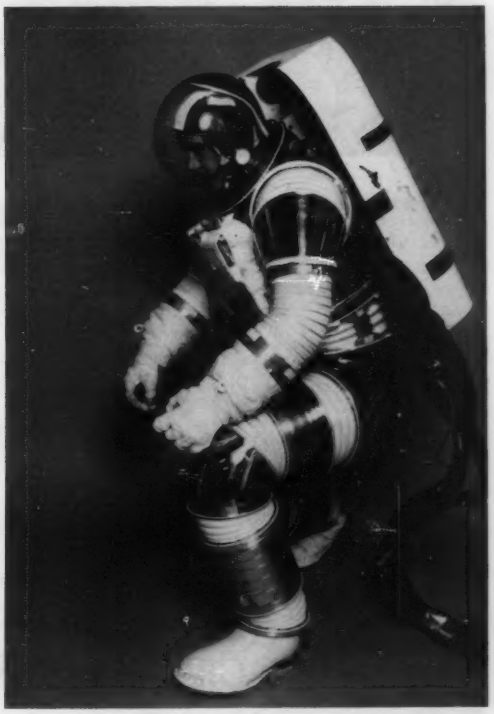
Assembly Flight 5

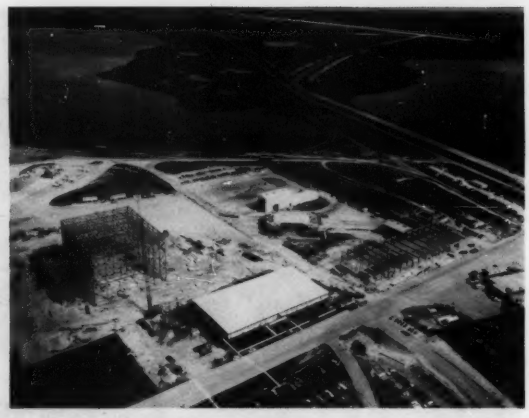




Assembly Flight 1.
This sequence of computer-drawn pictures shows the flight-by-flight assembly sequence for the permanently manned Space Station.

Pre Breath Suit.





Top Left:

The Numerical Aerodynamic Simulation Facility at NASA-Ames Research Center. The building houses the most powerful supercomputer system in the world. The NAS system will be used to solve complex equations that predict the pattern of airflow around proposed aircraft designs. In effect, scientists can "fly" an aircraft design in the computers. NAS also will be used for research in weather modeling, computational chemistry and computational astrophysics.

Bottom Left:

Fluid Mechanics Laboratory

NASA's new research laboratory is a 21,000 square foot, $2.35 million facility at Ames Research Center designed for advanced experimental and computational research in fluid mechanics.

Researching using this facility will lead to safer, more fuel efficient aircraft and expand our knowledge of the fluid dynamics of aircraft and its components in both terrestrial and extraterrestrial atmosphere.

Top Right:

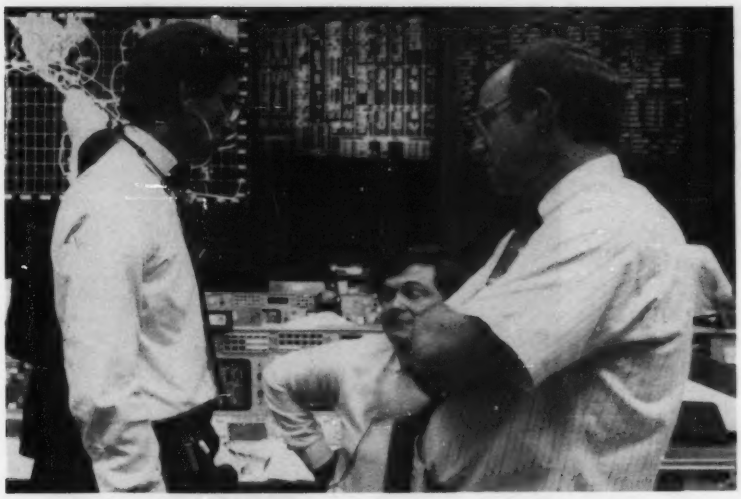
A view from the roof of the Vehicle Assembly Building shows continued construction of two new facilities at KSC. On the right is the new Shuttle Orbiter Modification and Refurbishment Facility (OMRF) which will be part of NASA's long range plan providing additional space to perform orbiter modifications and rehabilitations outside the facilities used in the normal operational flow. To the left construction has begun on the new Thermal Protection System Facility (TPSF). The TPSF will have the capability of repairing tiles that may have been damaged on re-entry.

Bottom Right:

Solid Rocket Motor Test Facility Completed at Marshall.

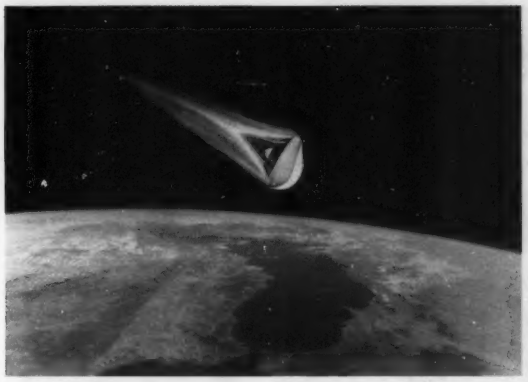
NASA's Marshall Space Flight Center in Huntsville, Ala., has completed construction of its Transient Pressure Test Facility which will be used for a series of Space Shuttle solid rocket motor tests begun in early November. The tests are to verify the ignition pressure dynamics of the motor.

FACILITIES



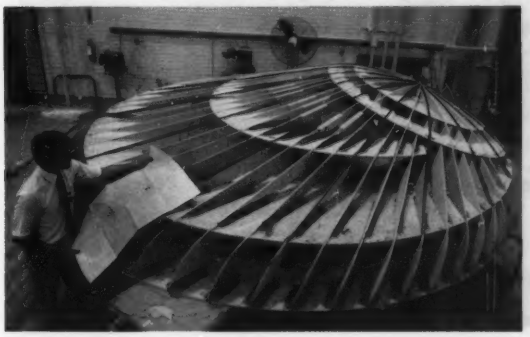
Above: **Mission ops team makes grade**

JSC's mission operations team passed its recent 56-hour test with high marks, overcoming 180 malfunctions to successfully complete every aspect of the simulated STS 61M(T) flight. Ascent/ Entry Flight Director Ron Dittemore talks to Tommy Holloway, Chief of Flight Crew Operations, and EECOM R. John Rector.



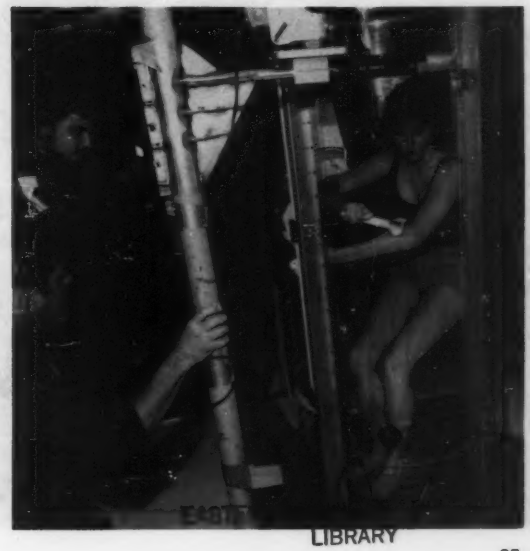
Left: **Putting on the Brake.**
Technical design team gives aerobrake concept shape and substance from start to finish.

Below: **Designer John Kahn** compares the framework for the aerobrake mock-up with his construction plans.



Space Station Shower gets most from every drop.

Shower test subject Paige Lucas, a JSC co-op, uses a vacuum hose to remove water from her skin as Rafael Garcia and Bob Williams (foreground) monitor her progress in the zero-g simulating KC-135 airplane.



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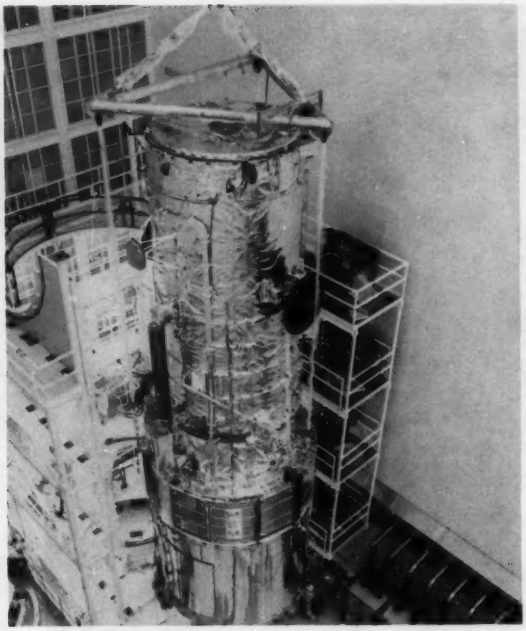
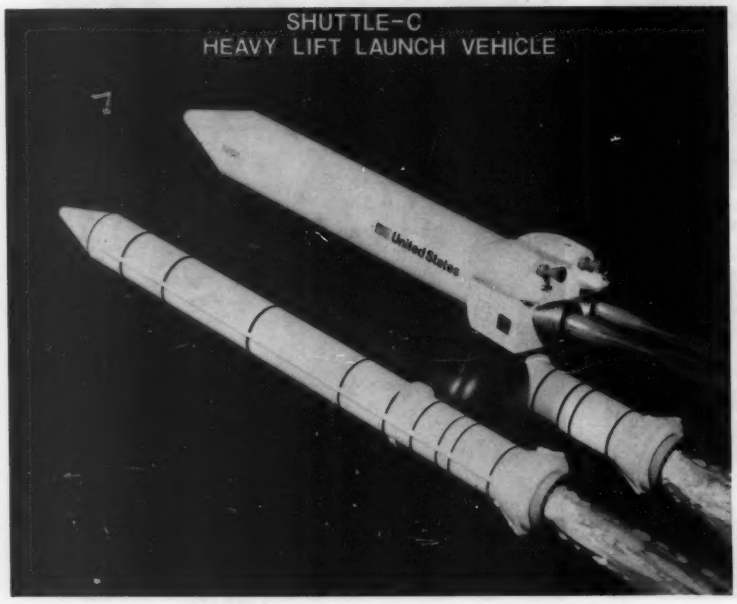
MARSHALL



NASA's Hubble Space Telescope is lifted from its workstand in the clean room at Lockheed Missiles and Space Company, Sunnyvale, Calif. The assembeld telescope and its supporting ground system underwent checkout and fine tuning this year, in preparation for launch aboard the Space Shuttle in June, 1989. NASA's Marshall Space Flight Center in Huntsville, Ala., is responsible for managing development of this premier astronomical observatory.



Shuttle-C Study Contractors

On October 22 NASA announced selection of Martin Marietta Manned Space Systems, New Orleans, La.; Rockwell International, Space Transportation Systems Division, Downey, Calif.; and United Technologies Corp., USBI Booster Production Co., Inc., Huntsville, Ala., for negotiations leading to parallel contract awards to perform the first of a two-phase systems definition study for a proposed unmanned, cargo-carrying launch vehicle.

Frontiers of Human Imagination.

October 30, 1987—Vice President George Bush tries on a Man Maneuvering Unit at the Marshall Space Flight Center. Talking about "the future direction of our space program", the Vice President told Marshall employees, "you are working on the frontiers of human imagination." Referring to "Mission to the Planet Earth," Bush urged NASA to "use the great energy and excitement of our expeditions into space to look back, to discover what it is we are doing to our Earth."

Practicing for the Future—Members of the Gamma Ray Imaging Telescope Study team practice installing an inflatible mirror support for a proposed orbiting astronomical observatory which would involve converting a Space Shuttle's external fuel tank into a giant pressure vessel to house the telescope. Working in space suits at the Marshall Space Flight Center's Neutral Buoyancy Simulator are: left, Steve Elrod, and right, Elaine Hinman. Supporting divers are, top to bottom: Homer Hickham, Topper Birney, and Joe Dabbs.

MARSHALL

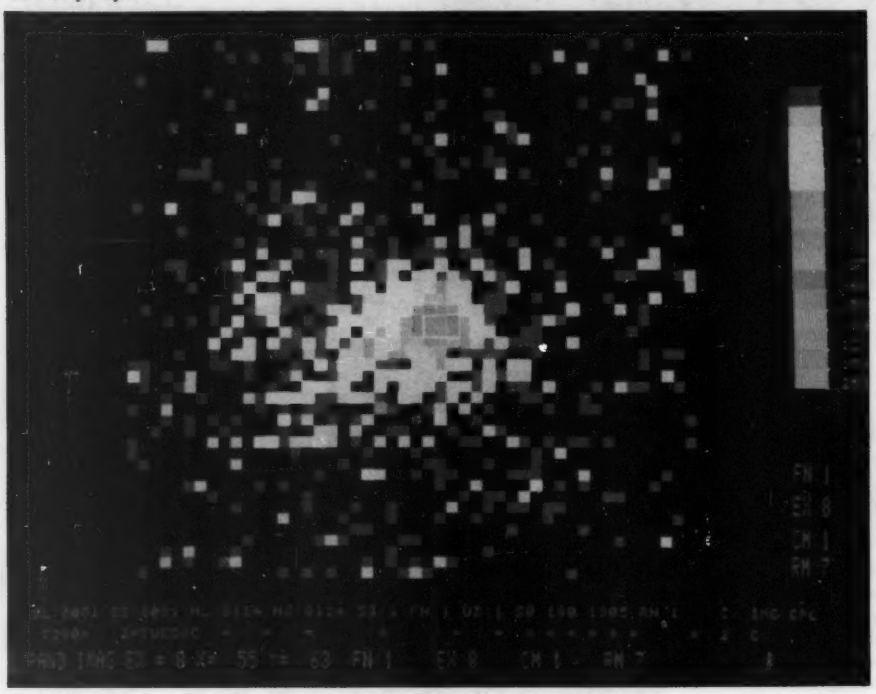
MARCH 26, 1987

Marshall Employees Selected NASA Inventors of the Year

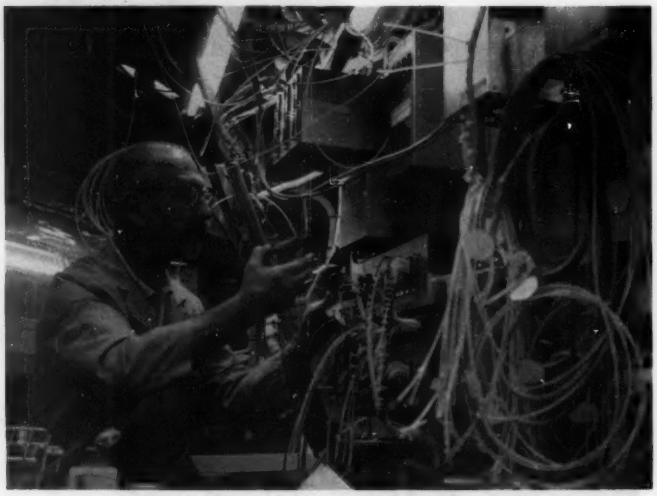
This is the thrid straight year that the Marshall employees have won the NASA award.

Ernest O. Bayless (left) and Samuel D. Clark, inspect an arc welding torch. The torch was invented by Bayless and Clark and won the duo NASA Inventors of the Year honors for 1986. The torch is used in development work at Marshall and in building the Space Shuttle external tank at the NASA's Michoud Assembly Facility in New Orleans.

Milky Way Neighbor—Goddard scientists say that the International Ultraviolet Explorer (IUE) satellite has performed superbly since February 24, when regularly scheduled operations were interrupted to focus IUE's 18-inch telescope, the largest now operating in space, on the supernova in the Large Magellanic Cloud, a neighbor galaxy of our Milky Way.



Wired for Big Bang Sound—Looks like it might be a spaghetti factory, but Don J. Fields, Code 754, really is just cabling a mock-up of the Cosmic Background Explorer (COBE). COBE will try to "hear" noises emitted 15 million years ago—at the time of the "Big Bang," the primeval explosion that started the expansion of the universe. COBE currently is scheduled for a Delta launch in 1989.



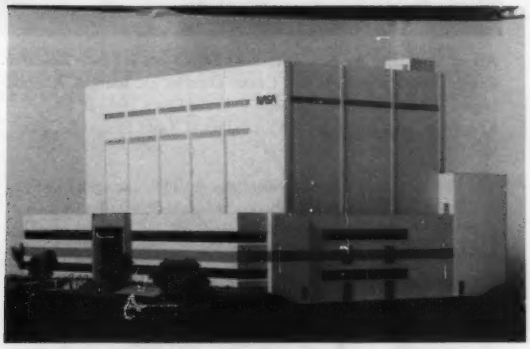
GODDARD

Changing Hands—Former Center Director Dr. Noel W. Hinners (right) presents new Center Director Dr. John W. Townsend, Jr. with a model of the Tracking and Data Relay Satellite.

Dr. Noel W. Hinners announced in a special address to Goddard employees that he had accepted a post at NASA Headquarters as Associate Deputy Administrator (Institution), effective June 22.

Goddard's new Center Director, Dr. John W. "Jack" Townsend, Jr., is no stranger to the Center. He was Goddard's Assistant Director, Space Science and Satellite Applications beginning in 1959 and was appointed Deputy Director in 1965.

Jack said, "It's good to be back."



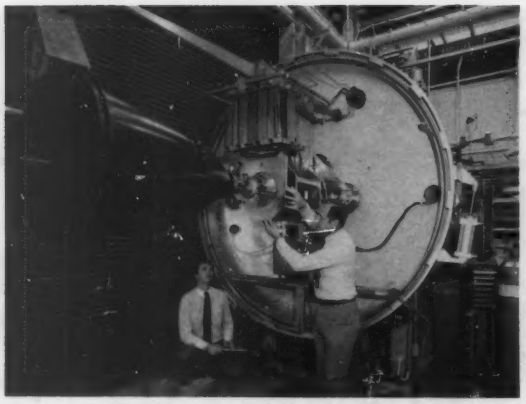
Below: **New Ground Station For TDRSS**—This is an artist's concept of the second Tracking and Data Relay Satellite System (TDRSS) ground station being built at White Sands New Mexico. This station will serve as a backup to the existing ground station and will support the increased mission requirements in the Nation's space program in the mid-1990s.

Left: **Contamination Free**—The World's largest laminar flow clean room will be located at Goddard when the construction for the Spacecraft Systems Development and Integration Facility (SSDIF) is complete in 1989.

A ground breaking ceremony was held at Goddard on June 10 for a facility that will contain the world's largest clean room of its type.

The facility will give Goddard the capability to handle large payloads. When completed in 1989. the SSDIF will provide approximately 78,000 square feet of floor space.

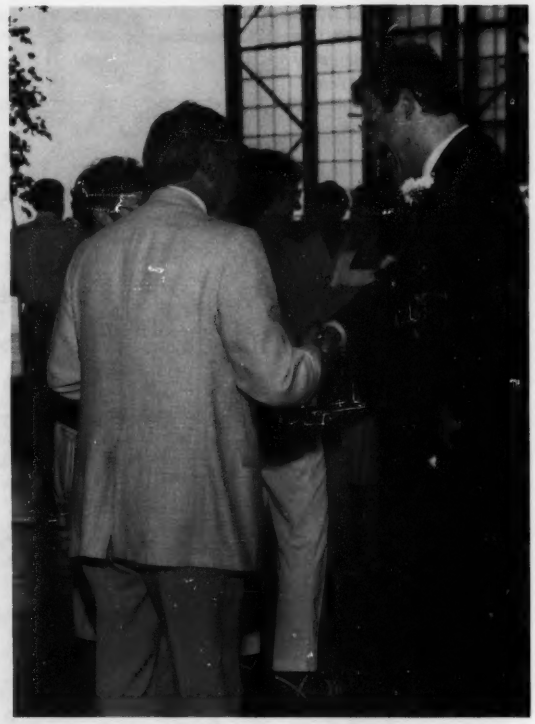
Below: **Spectral Image**—Dr. George Sonneborn, Computer Science Corporation staff astronomer (back) and Dr. Joji Kondo, International Ultraviolet Explorer (IUE) Project Scientist (front) view a spectral image produced by the IUE. Sonneborn used spectral data from the IUE to determine that a blue super-giant was the star which created Supernova 1987a.



Largest Area Ratio Rocket Nozzel Ever Tested: Scientists at Lewis Research Center are conducting a continuing investigation of the performance of high-area-ratio rocket nozzles.

Stovl Aircraft Technology Development—This model of the McDonnell Douglas 279-3 aircraft underwent wind tunnel tests at Lewis Research Center's 9x15-foot Low Speed Wind Tunnel. The model is a conceptual design for a supersonic STOVL (short takeoff, vertical landing) aircraft.

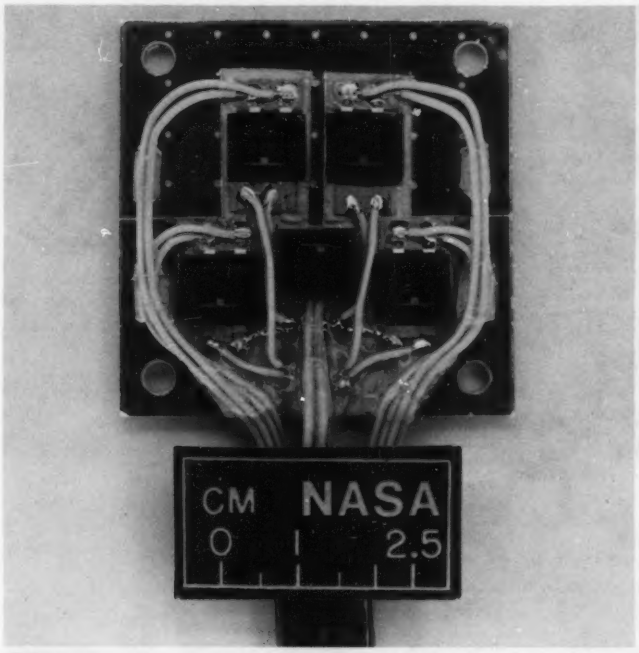
Left: **Power Systems Facility for Space Station Tests**—A new Power Systems Facility is being constructed at LeRC to support testing of the Space Station power system. The 26,000 sq. ft. facility will include an 8300 sq. ft., 55-ft. high, L-shaped class 100,000 clean room. It is scheduled for completion in December of 1988.



Above: **Greeting the New Director:** Employees at Lewis Research Center congratulated the new Center Director Dr. John M. Klineberg (right) and his family at a reception in the Lewis Hangar. Dr. Klineberg, who began his NASA career at Ames Research Center, had served as deputy director at Lewis since 1979.

LEWIS

Below: **Lewis Information Management System:** Employees at Lewis Research Center will soon be able to communicate much more quickly and effectively thanks to the Lewis Information Management System (LIMS) that is currently being installed.



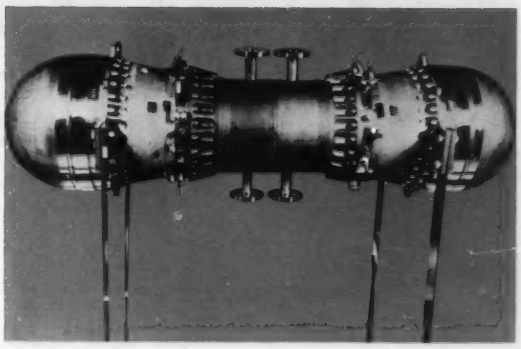
More Efficient Solar Cells—Indium phosphide solar cells have excellent potential for producing significantly more output power in the space radiation environment than either silicon or gallium arsenide cells that are currently used. The world's first space flight test module of indium phosphide solar cells was developed by Lewis Research center and is currently in orbit aboard a satellite.

LEWIS

Below: **Automotive Stirling Engine Test**—This truck can run on a variety of fuels—including jet fuel—because its standard engine has been replaced with a Mod I Stirling Engine. Lewis Research Center is managing the Automotive Stirling Engine Program under a U.S. Department of Energy program to develop technology for alternative automotive engines.

Below:

Advancing Space Communications Technology—This exceptionally small receiver for microwave communications, shown here in comparison to a dime, was developed by Hughes Corp. under a contract managed by Lewis Research Center. This 30 GHz receiver was developed to meet the space communications needs of possible future NASA missions, such as the Mars Rover.



Right: **A Stirling Example—**

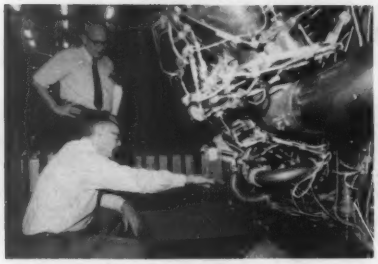
Free-Piston Stirling Engine for Space Power Applications—Lewis Research Center scientists are continuing tests of a 25 kW free-piston Stirling engine for space power applications. The potential advantages of free-piston Stirling engines for space applications include high efficiency, extremely low vibration, simple components, and growth capability.

Technology Transfer Transfer

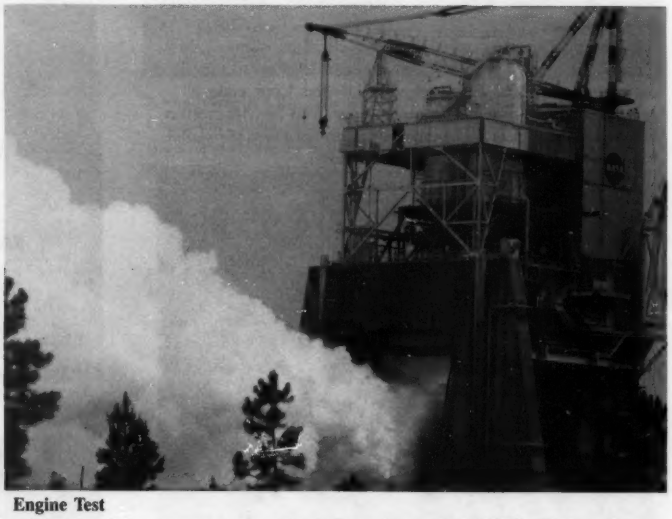
Mississippi Gov. Bill Allain, Rear Adm. Richard Truly and NSTL Director Jerry Hlass signed the official document transferring the Mississippi Technology Transfer Center from the state to the federal government.

The STS-26 crew viewed a Space Shuttle test firing during their visit March 13. The astronauts also presented Snoopy awards during their visit.

NSTL

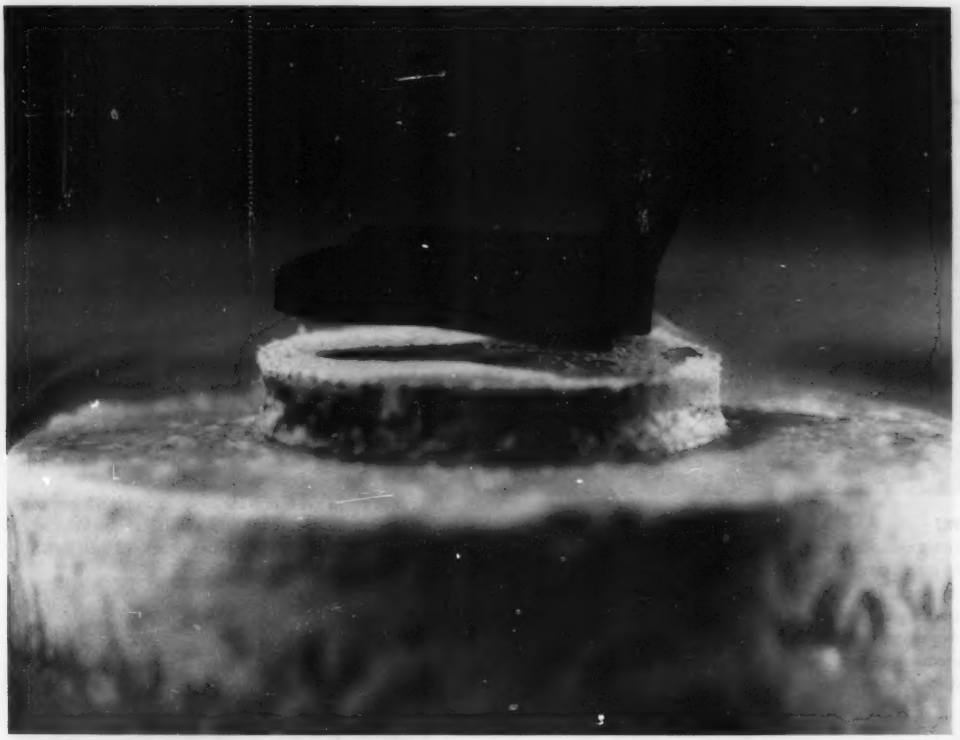


Dr. Dale Myers inspects a Shuttle main engine during his July 22 visits to NSTL.



Engine Test

Nineteen eighty-seven was a record year for engine testing at NSTL. To date, there have been 74 main engine test firings for a total run time of 30,922 seconds, including the longest test ever conducted in the Shuttle test program's 12-year history. The record test, conducted June 23, was 1,000 seconds in duration. The previous longest test was an 850-second firing conducted May 9 at NSTL.



Top: **Investigating Superconductors**

Langley Research Center is investigating one of the hottest and most promising fields in science—Superconductivity. Superconductors carry energy without the wasteful resistance found in normal conductors.

Langley is teamed with two universities on grant, Clemson University in South Carolina and Christopher Newport College in Virginia, to develop superconducting wires.

The illustration shows a model of the Shuttle, carved from a plastic magnet, levitated above a wafer of the barium-yttrium-copper oxide superconductor which loses electrical resistance at 94 degrees Kelvin. The wafer is resting on a copper block set into a bath of liquid nitrogen.

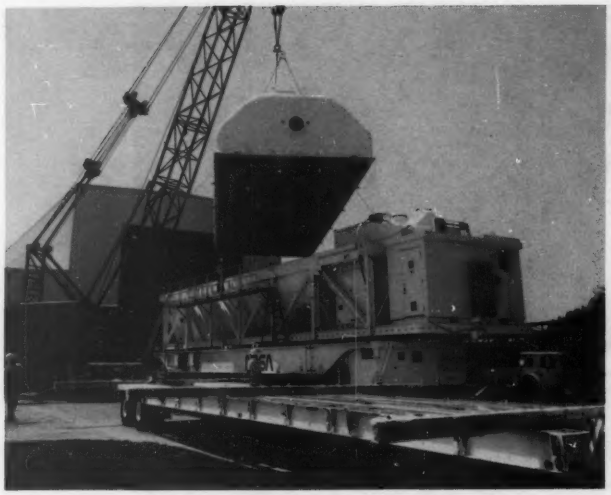
Finding a method to fabricate superconducting wires could revolutionize most uses of electricity and save billions of dollars in energy costs by permitting electricity to flow freely without the losses that are unavoidable in conventional wires. Langley sees applications for superconductors in long term space missions and improved sensors to monitor Earth's atmosphere.

LANGLEY

Right: **SCRAMJET**

In 1987 Langley continued to develop technology for hypersonic flight in areas of propulsion, structures and materials, aerodynamics and computational fluid dynamics. Here, a supersonic combustion ramjet (SCRAMJET) is being readied for test in the Scramjet Test Facility.

Several rectangualr engines similar to this scale research model might be mounted side by side under a future hypersonic cruise vehicle to power it through the atmosphere for atmospheric cruise or for boost into space, depending upon its mission.



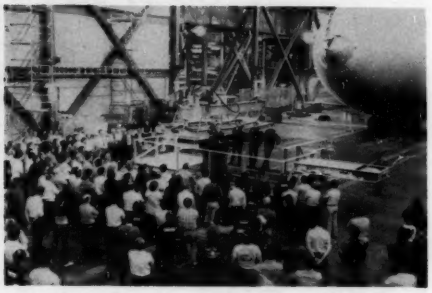
The 11,500 pound aluminum cap of the Hubble Space Telescope shipping container is removed in front of the MMSE building as testing and checkout of the container continues. The container will be used to transport the 43 foot long, 14 foot diameter telescope from Lockheed, Sunnyvale, California to KSC next year. The telescope is scheduled for launch aboard the Space Shuttle in November 1988.

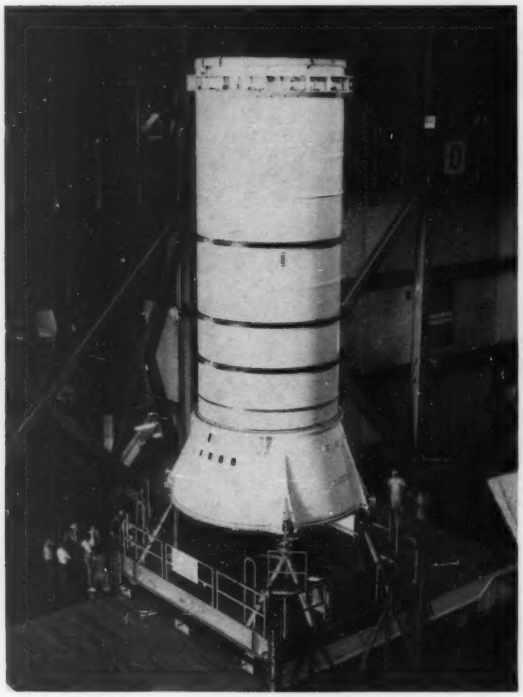
KSC

November 16, 1987

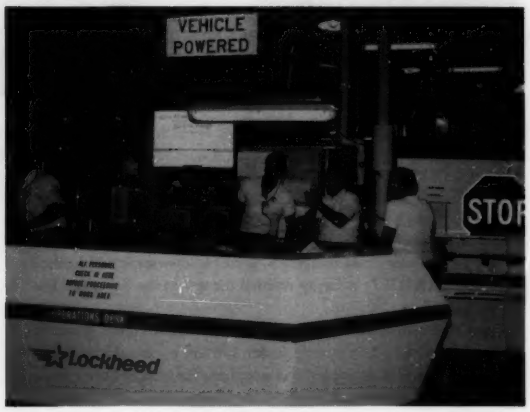
The aft solid rocket motor segment and aft skirt of the Assembly Test Article (ATA) are waiting, in the Vehicle Assembly Building transfer aisle, to be stacked on Mobile Launcher 3. ATA is a month-long exercise in stacking and destacking the redesigned solid rocket motors. The test began last week and is designed to verify putting the new field joint together with new tools, new equipment and new procedures. In addition the test will provide training for the ground crews.

The flight crew of STS-26 speak to NASA and contractor employees in the transfer aisle of the Vehicle Assembly Building during a motivational visit to KSC.



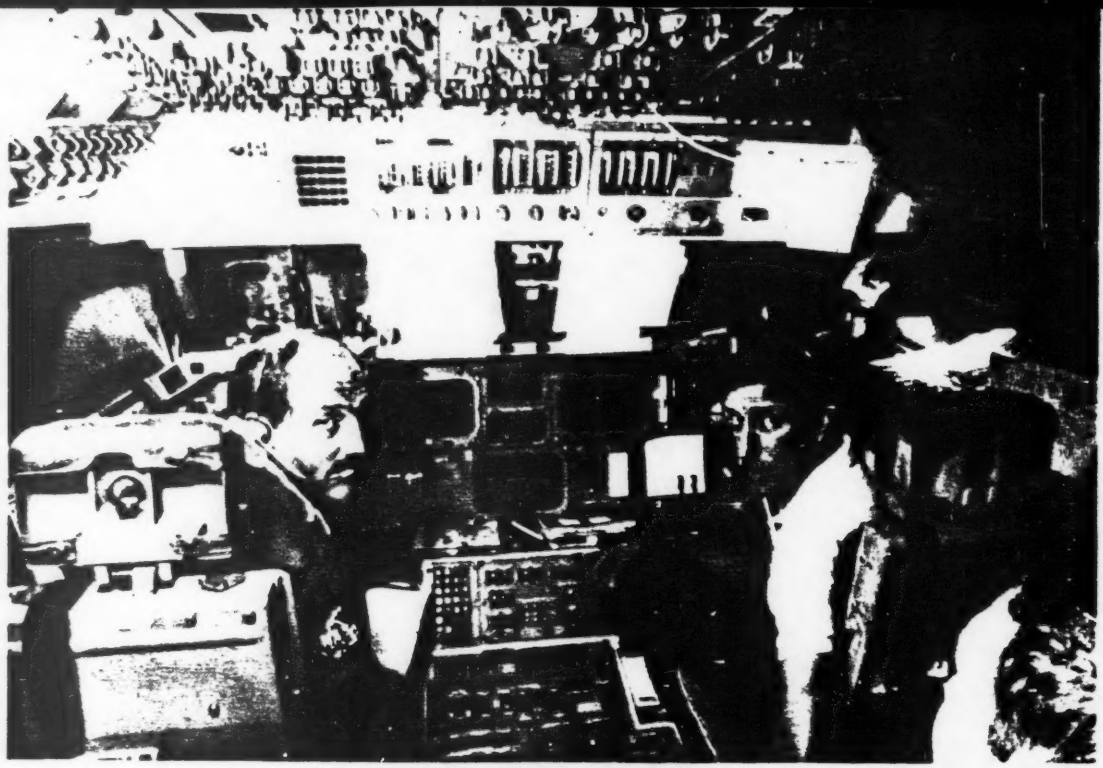


Smiles and applause emanate from the Orbiter Processing Facility as Discovery is powered up to support processing for launch in June 1988. Faces glow with joy and the once-dark "vehicle powered" sign glows with energy.



CALENDAR OF EVENTS FOR 1987

Date	Event
Jan. 5	NASA FY 88 budget briefing
Jan. 9	NASA management press conf & Philips report
Jan. 15	STS-26 crew press conference
Jan. 20	Shuttle status briefing
Jan. 28	Observance of Challenger accident
Jan. 28	Memorial service for Challenger crew
Feb. 8	Jesse Moore resigns from NASA
Feb. 15	Response to House Science & Tech Report
Feb. 17	Cantus new AA for External Affairs
Feb. 20	25th Anniversary of John Glenn flight
Feb. 26	Launch of GOES-H (Delta)
Mar. 4	Pioneer 9 declared dead (launch 11/8/68)
Mar. 9	NAS Super Computer Dedication
Mar. 16	NAS Report on NASA Space Goals
Mar. 20	Launch of Palapa-B2P (Delta)
Mar. 21	Dedication of 51-L Crew Common Grave
Mar. 26	Launch/Failure-Fltsatcom F-6 (Atlas Centaur)
Apr. 3	Va. site selected for Space Station office & revised design announced
Apr. 6	Campbell becomes new NASA Comptroller
Apr. 6	Fisk becomes new AA for Space Science
Apr. 13	Sheehan becomes AA for Commmunications
Apr. 15	Astronaut Young appointed to new post
Apr. 21	Launch delay of STS-26 announced
Apr. 24	Space Station RFP's issued
Apr. 27	Astronauts Hartsfield, Brandenstein, Bobko and Hawley named to new positions at JSC
May 11	Final briefing — Atlas Centaur accident
May 20	June 1988 launch date for STS-26 announced
May 26	Astronaut Ride announces plan to leave NASA
May 27	1st full-size solid rocket motor test firing
May 29	Klineberg named Lewis Center director
June 1	Office of Exploration established
June 3	District Court orders release of 51-L tape
June 4	NASA outlines safety "whistle-blowing" system
June 5	15 new astronaut candidates announced
June 8–12	Shuttle Arrest System tests
June 9	Orion Rocket lighting strike/destroyed
June 11	Paris Air Show begins
June 12	Release of NASA policy statements on future commercial space activities
June 21	Life Sciences Symposium Conference begins
June 22	4th Interim Report from NRC on Shuttle SRBs
June 22	Hinners becomes ADA (Institutions)
June 22	Townsend becomes director of GSFC
June 22	Justice Dept. drops charges against Beggs
June 30	Implementation to recommendations of Rogers Commission Report given to President
June 30	NRC Report on Space Station cost
July 13	Atlas Centaur 68 vehicle handling mishap
July 16	Press briefing on SRM redesign effort
July 22	2nd NRC report on Shuttle Criticality Review
July 28	Press conference on Antarctic ozone project
Aug. 5	Aaron becomes AA for Exploration
Aug. 10	Hinners named NASA Chief Scientist
Aug. 17	Sally Ride report released
Aug. 20	10th anniversary of Voyager spacecraft
Aug. 27	25th anniversary of Mariner II
Aug. 30	First full-scale test/redesigned SRB
Sept. 14	NRC report on Space Station Cost
Sept. 22	Announcement of Disney/JSC visitor center
Sept. 30	Post-investigation Ozone press conference
Oct. 22	Mixed fleet manifest released
Oct. 29	Balloon experiments begin in Australia
Nov. 2	Announcement — delay of Space Station contracts
Nov. 4	Atlas Centaur launch pad mishap report released
Nov. 4	GAO Report on NASA SRM procurement released
Nov. 19	TPTA test conducted



LOOKING BACK

NASA

National
Aeronautics and
Space
Administration

STS 26 SIMULATIONS—Looking back are Astronauts Frederick H. (Rick) Hauck, left, STS-26 commander, and Richard O. Covey, pilot, man their respective stations in the Shuttle mission simulator (fixed base) at the Johnson Space Center (JSC). A simulation for their anticipated June 1988 flight aboard the Discovery began Oct. 20. Astronaut David C. Hilmers, one of three mission Specialists for the flights, is partially visible in the foreground.

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